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Full Length Research Article

An Assessment of Water Quality by Evaluating various Physicochemical parameters of Sirpur lake Indore India

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ABSTRACT

Sirpur Lake is an essential water source of Indore district of Madhya Pradesh. It provides everything, i.e. life, money, religion and surveillance. But unfortunately the nature of human greed has affected it in such way that in the near future its own life is in threat by means of the anthropogenic pressure on it. With all these certain things in mind an attempt was made during year January–December 2018 to find the status of the lake. Of the studied parameters (Temperature, Transparency, pH, Total hardness, Dissolved oxygen, Biological oxygen demand, Chloride, and Phosphate). most of them lies in the permissible value when compared with WHO and BIS standards. However Dissolved oxygen and phosphate were found well above the recommended values which were mostly due to excessive use of inorganic fertilizers in the agricultural lands. For drinking purposes NSF-WQI was used season wise which showed the water quality falls in the medium range (50-70) at all the stations during all seasons.

Introduction

Water is a prime natural resource, life, a basic human need, element of social and economic infrastructure, and is essential for healthy society and sustainable development (Tiwari, 2000). Water is absolutely essential not only for survival of human beings, but also for animals, plants and all other living beings. It has many beneficial uses such as drinking, irrigation, navigation, propagation of wild life, fisheries, recreation; aesthetics etc. (Gupta, et al 2009; Abhineet and Dohare 2014). But nowadays the availability of clean water has become the biggest problem all over the world because all the source such as rivers, lakes, streams, springs etc. are polluted day by day. The main cause of pollution is human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff (Meitei et al., 2004). The pollution of fresh water resources has direct impact on human health via various diseases.

The World Health Organization (WHO) estimates that about 1.1 billion people globally drink unsafe water (Kindhauser, 2003) and the vast majority of diarrheal disease in the world (88%) is attributable to unsafe water, sanitation and hygiene (WHO, 2003). Approximately 3.1% of annual deaths (1.7 million) and 3.7% of the annual health burden (Disability adjusted life years

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[DALYs]) worldwide (54.2 million) are attributable to unsafe water, sanitation and hygiene. Due to interactions between exposures to enteric pathogens via poor quality water, lack of sanitation and derisory hygiene, data resolving the water borne component is not generally available (Ashbolt, 2004). Among already mentioned resources of fresh water, the lakes are considered the ultimate source not only for drinking purpose but also for agriculture, industrial and religious purposes most particularly in India where more than 50% gross income depends on agriculture, and people consider them as God.

The main responsibility of water bodies were to provide safe and clean water but nowadays people has shifted their duties as they are used as pits for disposal of domestic cum industrial wastes, trenches for holding the toilet wastes and tanks for storing the highly toxic chemicals used in agricultural lands. All these irresponsible activities are becoming the most dangerous threat in the near future for the entire life. Sirpur Lake is falling in the same category that is it is receiving huge amount of domestic cum industrial wastes. A study was made to find the status of water quality of the lake by evaluating the various physico chemical parameters so that effective measures can be made to fix its problems associated with its water quality.

Material and methods

Description of study Area

The Sirpur Lake of Indore situated close to the western periphery of the city along the NH 59 is a grand water reservoir. The total area of the lake and its surrounding protected region is 800 acres (around 3.6 square kilometers). Sirpur Lake was created by the Holkars of Indore State in the early 20th century. After the independence of India and extinction of the royal houses, religious sites started mushrooming up around the lake and over the years it was encroached upon by the people living in its vicinity. Illegal activities like fishing, poaching, cattle grazing, waste dumping, etc., almost destroyed the lake's ecology.

Sampling

The water sampling was done in the last week of each month from January 2018 to December 2018. The water samples were collected in 2 liter polythene cans from all the stations. Few parameters such as temperature, transparency and PH were determined at the Station by using 0.1 scale thermometer, Sacchi disc and pocket type digital PH meter (calibrated by PH 7 and PH 4 buffer tablets) respectively. The remaining parameters were determined in the laboratory as per the standards (APHA 2011; NEERI 1986).

Data analysis: mean, maximum and minimum values were obtained by using MS excel 2007. Standard deviation and standard error was calculated by using the online calculator. Water quality was obtained seasonally according to NSF WQI by using the following formula

$$NSFWQI = \sum_{i=1}^p WiQi$$

Results and Discussion

The average value, standard deviation, and WHO and BIS standard permissible values are shown in Table 1. Temperature an important factor, not only influences the biological factors but also the physical and chemical factors. (Kumar *et al.* (1996). Study of temperature is an essential factor because it stresses the various parameters such as dissolved oxygen which results in the death of various living organisms living in them (Kumar and Puri, 2012). The average temperature along with standard error of the Sirpur Lake is 27.8 ± 1.16 . The highest temperature 35.5 was observed in the month of June and that of lowest 16 in the month of December 2017. The main reason for highest temperature is climatic condition. Lowest temperature is due to low ambient temperature as January is considered coldest month of year.

Transparency an important ecological parameter of any water body depends on intensity of sun light, dissolved and suspended solids, vegetation, rate of the flow, and current of the water. (Mishra and Saksena, 1991; Singh, 1999; Kulshrestha and Sharma, 2006). Variation in transparency depends upon seasons. High values are generally observed in pre-monsoon and winter seasons while low values are in the monsoon season. Similar results were observed for Sirpur Lake. The average value of Transparency for year is 2018 was 22.63 ± 1.21 . The main reason for different values is turbid water with high turbidity during monsoon and large biological productivity in the pre-monsoon season that is high density of planktons (Singh *et al.* 1999). pH a numerical scale which determines the acidity and alkalinity of a solution is generally defined as the power of hydrogen

concentration. It is considered an essential factor because it directly affects the biotic components of any aquatic ecosystem. Value of PH depends on the photosynthetic activity due to utilization of carbon dioxide and conversion of bicarbonate ions into carbonate ions (Baijot *et al.*, 1994). Higher values of pH have been observed in summer season due to high photosynthetic activities. The value of pH during year 2018 was 8.95 ± 0.15 . The pH of lake lies in the permissible range i.e. $6.5 - 9.2$ as per the standards of WHO and BIS. The observed results suggest that the water is slightly alkaline in nature.

Total hardness an effect of carbonate and bicarbonate ions of calcium and magnesium is an important parameter which gives an idea about the domestic activities such as washing clothes, car washing and industrial purposes (Matta, G. 2014). Hard water, soft water is often used by common people due to its effect on human health hence evaluating total hardness of any water body is essential step. In the current study the average value of total hardness lies in the same zone as the other normal oligotrophic lakes of India possess. It was in the permissible range (200 -0600 mg/l) WHO & BIS standards. The value of Total hardness was 149.17 ± 3.33 and 150.83 ± 2.9 (Total hardness \pm SE). Highest value 195 mg/l was observed in the month of June. (Soni, V K, 2011) also found the highest value in the same month and suggest the idea of eutrophication.

For water quality assessment, dissolved oxygen is a parameter which determines whether biological changes are brought about by aerobic and anaerobic organisms (Saksena and Kaushik, 1994). It reflects the overall processes prevailing in the water. Depletion of DO in any aquatic system results in respiration stress which leads to the mass destruction of biota inhibiting the ecosystem. In the present study the average value of dissolved oxygen found in different Seasons are 6.93 ± 0.52 . The observed values are above the permissible value i.e. 6 as per the standards of WHO and BIS. Similar results were observed during different studies (Jain, 2002; Adeyemo *et al.*, 2008).

Biological oxygen demand is defined as the demand for the requirement of oxygen by bio organisms to stabilize the organic compound under aerobic conditions. Thus it is an important and alone parameter which can be used to assess the pollution load of any aquatic ecosystem. BOD generally related with disposal of sewage and industrial wastes carrying the heavy organic pollutants. High value of BOD shows high pollution which results in release of organic nutrients in water bodies resulting in death of organisms thriving on water and vice versa (Jonasson *et al.* 2012). In the current study Sirpur Lake showed the BOD in the permissible value i.e. <3 as per WHO and BIS. The average value of Sirpur was 2.73 ± 0.08 . The values showed that the water source is polluted but not heavily as the value is little below the standards.

Phosphate, the inorganic pollutant coming out from the source of domestic sewage, agricultural runoff, industrial wastes, detergents and from natural sources i.e. from rocks (Sinha *et al.* 2000). Its presence is the sign of eutrophication and also provides the idea of human pressure Sharma *et al.* (2009). During current study the study Station showed higher values of phosphate which were also above the permissible values of (BIS). The average value of year 2018 was 4.78 ± 0.28 . Maximum value was observed

was (6.2mg/l) and lowest value was (2mg/l). The maximum value of Phosphate might be due to intense use of fertilizers in the agricultural fields surrounding the lake.

Chloride an important component of an aquatic ecosystem comes from both natural sources as well as from domestic sewage, industrial effluents etc. It gives an idea of anthropogenic pressure, presence of organic pollutants and nitrite ions (Pandith R B and Solanki H A 2004). However its higher concentration is

dangerous due to its high reactivity and formation of secondary pollutants and makes water unpleasant (Padmanabha and Belagali, 2001). In the current study evaluation of chloride concentration was also made. The average value falls in the permissible value as per WHO and BIS. 59.37 ±1.59 was the average value of the lake. Highest value 59mg/l was found in the month of June and lowest value 20 mg/l was in December. Similar types of results were found for reservoirs of Narmada River by Soni V.K.et al, 2014.

Table 1: Average values of parameters studied during the year 2018.

Parameters	Average ± S.E	WHO	BIS
Temperature °c	35.5±0.14	N/A	N/A
TRANSPARENCY-cm	22.63±1.21	N/A	N/A
PH	8.95±0.15	6.5-8.5	6.5-8.5
TOTAL HARDNESS mg/l	149.17±3.33	200-600	200-600
DO mg/l	6.93±0.52	6	6
BOD mg/l	2.73±0.08.	3	<3
PHOSPHATE mg/l	4.78±0.28		45
CHLORIDE mg/l	59.37 ±1.59	200-600	250-1000

N/A: not available

National Sanitation Foundation Water Quality Index (NSF WQI) used for rating of water quality indicates that the quality of water is in medium range (WQI= 50 - 70). The seasonal values obtained during study period are shown below (table b). With further increase of anthropogenic pressure it is almost always endangered or deteriorated. The condition in it usually diverges from normal levels and the water is hardly able to protect or support plenty of aquatic life. Phosphorus, dissolved oxygen, total alkalinity and total solids are the main factors responsible

for determination of the river water quality. These parameters need to be modified to maintain the quality of water for further use. NSF-WQI is an excellent management and general administrative tool in communicating water quality information. This index has been widely field tested and applied to data from a number of different geographical areas all over the world in order to calculate Water Quality Index(WQI) of various water bodies, critical pollution parameters were considered.

Table 2: Vvalue of water quality as per NSF-WQI during year 2018

Winter		Pre monsoon		Monsoon		Post monsoon	
value	quality	value	quality	value	quality	value	quality
58	Medium	51	Medium	56	Medium	62	Medium
NSF-WQI standards							
				Range		Quality	
				90 -100		Excellent	
				70 - 90		Good	
				50 - 70		Medium	
				25 - 50		Bad	
				0 - 25		Very bad	

Conclusion

On the basis of present study it was observed that the Sirpur Lake is still in living conditions but not as healthy as was expecting. It is evident from the data that different physicochemical parameters of water varied remarkably in different stretches of the river. Most of the parameters studied lies in the permissible value of WHO and BIS. However further increase in anthropogenic activities may affect its status and destroy its quality. So, various efforts has to be made yet for its long time surveillance. Water for drinking purposes has to be treated prior to the supply however for other purposes the current status can support the maximum living biomass.

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